

Name of Study: Evaluation of in-stream habitat improvement in a southwest Michigan trout stream.

- A. Problem:** Adding in-stream structure to improve physical stream habitat is a common management practice by fisheries managers hoping to increase some combination of recruitment, survival, growth, biomass, and angler catch rates of game species such as trout. However, thorough evaluations of the effectiveness of habitat improvement projects are rarely conducted. Common deficiencies in evaluations that are conducted include lack of documentation, pretreatment data, controls, and thorough statistical analyses. Habitat data are seldom available to evaluate whether in-stream structures have a desirable effect on channel morphology, and concurrent data on angler effort, catch rates, and harvest rarely exist to determine if perceived changes in fish populations are the result of habitat improvement or the change in fishing pressure that often accompanies such efforts. A rigorous evaluation of in-stream habitat improvement will provide fisheries managers with much needed information about the effectiveness of this management technique so that future endeavors are beneficial and cost-effective.
- B. Objective:** The objective of this study is to determine if the addition of in-stream structure improved physical habitat in Silver Creek, Kalamazoo County, Michigan and increased the abundance (numbers and biomass), survival, growth, and angler catch rates of brown trout *Salmo trutta* and brook trout *Salvelinus fontinalis*.
- C. Justification:** The Michigan Department of Natural Resources Fisheries Division strives to protect, rehabilitate, and improve stream habitat and function through the use of appropriate management techniques and best management practices to provide a realized benefit to aquatic communities. Stream habitat improvement, a common management technique, has been recently criticized because of its high cost and lack of scientifically rigorous evaluation. Through a single case study, evaluation of stream habitat improvement in Silver Creek will measure the effectiveness of adding in-stream structure to a degraded section of a southern Michigan wild trout stream, thereby helping to determine if fisheries management objectives were met. This effort will assist in identifying areas for improvement in future work and help to ensure that such work is beneficial and cost-effective.

Evaluation of stream habitat improvement effects on both channel morphology and target fish species has also been identified by Fisheries Division as a high priority research need. This study addresses both biotic and abiotic effects of stream habitat improvement. Because pre- and post-treatment data have already been collected to characterize attributes of both channel morphology and trout population dynamics little or no field work is required to complete this analysis. Thus, a research report or journal manuscript containing information useful to fisheries managers can be produced in a short period of time at low cost.

- D. Expected Results and Benefits:** Results of this study will assist fisheries managers in making decisions on the effectiveness of habitat improvement in Michigan trout streams by estimating the effects of in-stream structure addition on trout abundance, survival, growth, and angler catch rates in Silver Creek. If in-stream structure additions increase the biomass of trout, angler catch rates and satisfaction may also increase, thereby enhancing the recreational benefits and public value generated by trout streams. This study will also evaluate whether in-stream structure additions achieved desirable changes in channel morphology such as stream narrowing and

deepening and increased exposure of coarse substrate. This study is an attempt to reduce the uncertainty about the effects of in-stream structure additions on channel morphology and the resident trout population in a Michigan stream.

- E. Background:** Adding structure to trout streams to improve physical habitat originated in Michigan in the early 1900s to remediate loss of cover, pollution, and overfishing. These efforts were intensively studied at the time, and by the late 1930's the use of in-stream structure as a fisheries management tool became common practice. The results of early studies (e.g. Hubbs et al. 1932; Shetter et al. 1946; Tarzwell 1936) and even more recent work in Wisconsin (Hunt 1976, 1988) indicated benefits to trout populations, particularly increases in abundance. Improving in-stream habitat by adding structure to stabilize stream banks, provide overhead cover, and diversify channel morphology has experienced resurgence in the past two decades (Thompson 2006), with many of the original techniques developed early in the 20th century still used by fisheries managers today.

Although in-stream habitat improvement is a common practice, modern evaluations are rare and share similar shortcomings, including lack of pretreatment data, controls, and rigorous statistical analyses. Habitat data are often unavailable to determine if the addition of structure achieves desirable effects on channel morphology. Population responses are poorly measured, and many evaluations fail to account for changes in fishing pressure, which can complicate interpretation of the influence of in-stream structures (Thompson 2006). These shortcomings create a problem for fisheries managers faced with making decisions on the effectiveness and appropriate use of structure to improve physical stream habitat in hopes of increasing the abundance, survival, growth, and ultimately catch rates of game species such as trout.

Silver Creek is a small second-order tributary to the Kalamazoo River, Michigan. Located in the extreme corner of southeastern Allegan County and north-central Kalamazoo County, this high-quality designated trout stream has a top-quality reputation for its coldwater fishery. Significant natural reproduction of brown trout and limited natural reproduction of brook trout provide excellent angling opportunities (Dexter 1993). In 1995, a habitat improvement project was initiated in Silver Creek to remediate the effects of poor land use practices, including the operation of a cattle farm that caused severe stream bank erosion. Fencing and in-stream structures were installed in a treatment zone at the cattle farm to stabilize the stream banks and provide overhead cover, with the intent of creating more desirable channel morphology and improving the trout fishery.

Between 1991 and 2004, trout population estimates, habitat data, and volunteer angler data (effort, catch, and harvest) were collected from Silver Creek to evaluate the addition of in-stream structures. Data were collected from the treatment zone of Silver Creek before and after habitat improvement and from an upstream reference zone where no structure was added. Reference population data were also collected during the same time period in nearby Spring Brook (Kalamazoo County). These data were archived and have not yet been analyzed.

- F. Procedure:** Trout population estimates, survival, growth, angler catch rates, and habitat data collected from Silver Creek between 1991 and 2004 will be assembled and formatted so comparisons of these metrics can be made in the treatment and reference zones before and after habitat improvement. We will also use trout population data collected during the same period from nearby Spring Brook as a control to determine if trout populations changed through time due to factors unrelated to additions of in-stream structure.

- Job 1. Assemble and format archived data. Trout population and channel morphology data currently archived at the MDNR Plainwell Operations Service Center will be transferred to the Hunt Creek Fisheries Research Station and placed into a format suitable for analysis with statistical software.
- Job 2. Analyze data to evaluate in-stream habitat improvement. Analysis of variance will be used to compare differences in trout populations, channel morphology, and angler catch rates between treatment and control reaches before and after habitat improvement. If suitable, volunteer angler data will also be used to account for changes in fishing pressure before and after the addition of in-stream structures.
- Job 3. Write research manuscript.
- Job 4. Write annual progress report. Annual progress reports will be prepared according to the established Federal aid timeline and format.
- Job 5. Publish manuscript. This job involves the editing and finishing work required to achieve final publication of a research report or journal manuscript.
- Job 6. Prepare final report citing the publication produced under Job 5.

G. Schedule/Budget¹:

Proposed work	2007-08	2008-09
Job 1 Assemble and format archived data.	4,774	NA
Job 2 Analyze data to evaluate in-stream habitat improvement.	5,870	NA
Job 3 Write research manuscript	4,774	NA
Job 4 Write annual progress report.	955	1,003
Job 5 Publish manuscript.	NA	15,017
Job 6 Prepare final report citing publication produced.	NA	501
Totals	16,373	16,521

¹ NA = not scheduled

H. Geographical Location: Hunt Creek Fisheries Research Station, Lewiston, Michigan; Plainwell Operations Service Center, Plainwell, Michigan; Institute for Fisheries Research, Ann Arbor, Michigan.

I. Personnel: Todd C. Wills and Andrew J. Nuhfer, Fisheries Research Biologists; James L. Dexter, Lake Michigan Basin Coordinator; Research Administrative personnel, and editor.

Literature Cited:

- Dexter, J. L. 1993. Silver Creek. Michigan Department of Natural Resources Status of the Fishery Report 93-3, Ann Arbor.
- Hubbs, C. L, J. R. Greeley, and C. M. Tarzwell. 1932. Methods for the improvement of Michigan trout streams. Bulletin of the Institute for Fisheries Research 1, Ann Arbor.
- Hunt R. L. 1976. A long-term evaluation of trout habitat development and its relation to improving management-oriented research. Transactions of the American Fisheries Society. 105: 361-364.
- Hunt, R. L. 1988. A compendium of 45 trout stream habitat development evaluations in Wisconsin during 1953-1985. Wisconsin Department of Natural Resources Technical Bulletin 162, Madison.
- Tarzwell, C. M. 1936. Experimental evidence of the value of trout stream improvements. Transactions of the American Fisheries Society 66:177-187.
- Thompson, D. M. 2006. Did the pre-1980 use of in-stream structures improve streams? A reanalysis of historical data. Ecological Applications 16: 284-796.
- Shetter, D. S., O. H. Clark, and A. S. Hazzard. 1946. The effects of deflectors in a section of a Michigan trout stream. Transactions of the American Fisheries Society 76:248-278.